

ORIGINAL RESEARCH



Developmental trends in academic emergency medicine journals, 2000 to 2019

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Abstract

We investigated academic developmental trends in emergency medicine (EM) by analyzing the performance of EM journals. Data from the Journal Citation Reports (JCR) database for EM category journals, including journal titles, language, numbers, and impact factors (IFs) from 2000 to 2019 were collected. The aggregate IFs of EM and 11 other categories (cardiac and cardiovascular systems, clinical neurology, critical care medicine, gastroenterology and hepatology, infectious diseases, general and internal medicine, pediatrics, respiratory system, surgery, toxicology, and urology and nephrology) were collected from 2003 to 2019. The slope of the linear regression was used to evaluate the trend in EM journal IFs and the aggregate IFs of all categories. Pearson's correlation coefficient was used to evaluate the correlation between EM journals' IF in 2000 and their IF trend from 2000 to 2019. The EM journal number increased from 8 (all in English) in 2000 to 31 (26 in English) in 2019. In total, 28 EM journals had a positive IF trend since their initial enrollment into the JCR database, and the trend was significant for 18 journals. The correlation of the EM journals' IF in 2000 and IF trends from 2000 to 2019 was 0.75. The increasing trend of aggregate IF for the EM category was significant. In conclusion, the increased number, language diversity, and IF trend for EM journals indicates that the development of academic EM is a continuous international trend. In the past 20 years, the IF trend increased faster for EM journals with a higher initial IF. The overall performance of EM journals was non-inferior to other medical specialties.

Keywords

Emergency medicine; Emergency medicine journal; Impact factor; Trend

1. Introduction

1.1 History of EM specialty

The inception of Emergency Medicine (EM) as a distinct clinical specialty began in the 1960s [1]. It was officially recognized as an autonomous medical specialty first in the United States, in 1973 [2]. In subsequent decades, EM gained global acceptance as a standalone specialty [3]. The evolution of academic EM was a natural progression from the rise of its clinical counterpart. Early contributions to the field came in the form of dedicated EM journals. The Journal of the American College of Emergency Physicians, which was later renamed as the Annals of Emergency Medicine in 1980 [4] along with Resuscitation [5] were first published in 1972. Since then, a multitude of EM-specific journals have been launched.

The Journal Citation Reports (JCR) database acknowledged EM as a unique category in 2000. This classification can be seen as an affirmation that EM-related research and journals have reached a significant milestone in terms of both quantity and quality [6, 7].

1.2 JCR database

The Journal Citation Reports (JCR) database is a component of the Science Citation Index, offering journal impact factors (IFs) as a metric for evaluating academic performance [8]. The concept of IF was introduced in 1955 by Eugene Garfield [9]. The impact factor of a journal is calculated using a division equation: the numerator consists of all citations over the previous two years, while the denominator includes all citable articles published during the same period [10]. The types of articles deemed citable are typically limited to peer-reviewed and review articles [11].

Nonetheless, there have been debates regarding selection bias toward articles classified as citable and the perceived marginalization of non-citable articles. Despite these discussions, the impact factor remains one of the most widely employed indicators of scientific journal performance [6, 12]. The category aggregate IF was introduced in the JCR database in 2003 and is based on a similar concept as the IF, being defined as the citations for all articles in one category in the previous two years divided by the total number of articles in

the same category published in the previous two years.

1.3 Evolution of academic EM

The increase in journal impact factors is typically associated with a rise in the average number of citations received by published articles. This growth in citations signifies a stronger linkage between the research topic and other related studies, which in turn can inspire further research in the field. Consequently, we have elected to incorporate EM journal impact factors as one of the indicators representing the advancement and growth of academic EM.

The evolution of academic performance in EM journals from 2000 and 2009 has previously been examined [6]. In addition, a 2012 study compared EM with other medical specialties from 2006 to 2010 [13]. To our knowledge, no studies have evaluated the academic performance of EM in relation to other medical specialties after 2010. Therefore, we conducted an investigation into the development of academic EM and other clinical specialties from 2000 to 2019, examining the data from the viewpoint of journal impact factors and category aggregate impact factors.

2. Methods

2.1 Study design and setting

We sourced the data from the Journal Citation Reports (JCR) database [14]. The period under study spanned from 2000 to 2019.

2.2 Selection of participants

The EM journal list was adopted from the 2019 JCR category of EM. We collected EM journals' data on journal titles, published language, citable items, and IF in each year from 2000 to 2019. In addition to category of EM, 11 categories of clinical medicine closely related to EM were chosen for comparison (cardiac and cardiovascular systems, clinical neurology, critical care medicine, gastroenterology and hepatology, infectious diseases, general and internal medicine, pediatrics, respiratory system, surgery, toxicology, and urology and nephrology) [6]. The total journal numbers in EM and the other 11 categories from 2000 to 2019 were collected. The aggregate IFs of the EM and 11 other categories were collected from 2003 to 2019.

2.3 Measurements

The primary outcome measurement was the IF trend for EM journals from the year of enrollment in the EM category, which represented the academic performance of EM journals.

The secondary outcome measurements were: (1) EM journal language and total EM journal number from 2000 to 2019, as indicators of the diversity and quantity of EM journals; (2) the correlation between EM journal IF in 2000 and the IF trend between 2000 and 2019; (3) the correlation between the 2003 to 2019 IF trend for leading EM journals (defined as those with a 2003 IF higher than the aggregate IF in 2003) and the fold increase in citable items between 2003 and 2019; and (4) the aggregate IF trend for EM and 11 other categories from 2003 to 2019, reflecting the academic performance of these categories.

2.4 Data analysis

Descriptive statistics were used to analyze the published languages and number of EM journals, total number of journals in all categories, difference between the EM journal IF and the EM aggregate IF in each year since 2003, and the fold increase in EM journal citable items between 2003 and 2019.

The slope of the linear regression was used to evaluate the trend in: (1) EM journal IFs from 2000 to 2019, (2) total number of journals in all categories from 2000 to 2019, and (3) aggregate IF for all selected categories from 2003 to 2019. The 95% confidence interval of the slope was calculated. Pearson's correlation coefficient was used to evaluate the correlation between: (1) the EM journal IF in 2000 and the IF trend from 2000 to 2019, and (2) the IF trend for leading EM journals between 2003 and 2019 and the fold increase in the number of citable items between 2003 and 2019. All analyses were performed using SAS statistical software version 9.2 (SAS Institute Inc., Cary, NC, USA).

3. Results

3.1 EM journal numbers and languages

There were 12 EM journals in the 2000 JCR database, the first year in which EM was an independent category. Four of these twelve EM journals were not included in the 2019 JCR EM category due to category changes, or termination of the publication [6] and were excluded from the study. All of the 12 EM journals in 2000 were published in English. There were 31 EM journals in the 2019 JCR database; 26 of the 31 journals were in English, 3 were in German, 1 in Spanish, and 1 in Turkish (Supplementary Table 1).

3.2 Trends in EM journal IF, EM aggregate IF, and citable items

The IF trends for 28 of the 31 EM journals were positive since the first year of inclusion in the EM category and were statistically significant for 18 of them ($p < 0.05$) (Table 1). The other three EM journals were newly enrolled in the JCR database and their 2018 IF was not available, so the IF trend could not be calculated. The correlation coefficient between the 2000 IFs of the eight EM journals enrolled since 2000 and their IF trends between 2000 and 2019 was 0.75 (Fig. 1).

In the 2003 JCR database, the IF of four EM journals (4 of 8, 50.0%) was higher than the EM category aggregate IF. These four journals were *Annals of Emergency Medicine*, *Resuscitation*, *Academic Emergency Medicine*, and *American Journal of Emergency Medicine*. In the 2019 JCR database, the IF of 12 EM journals (12 of 31, 38.7%) was higher than the EM category aggregate impact factor. Among these 12 journals, *Annals of Emergency Medicine*, *Resuscitation*, and *Academic Emergency Medicine* were the same as in 2003. The number of citable items from 2003 to 2019 of the four leading journals in 2003 (*Annals of Emergency Medicine*, *Resuscitation*, *Academic Emergency Medicine*, and *American Journal of Emergency Medicine*) increased by a factor 0.82, 2.07, 0.68, and 5.05, respectively. The correlation coefficient between the IF trend from 2003 to 2019 and the fold increase

TABLE 1. Impact factor (IF) trends of 2019 Journal Citation Reports category of emergency medicine journals between enrolled year and 2019.

Rank*	Journal title	Enrolled (yr)	IF in 2019	IF trend	p-value	95% CI
1	Annals of Emergency Medicine	2000	5.799	0.190	<0.001	0.174 to 0.207
2	Resuscitation	2000	4.215	0.217	<0.001	0.170 to 0.266
3	World Journal of Emergency Surgery	2012	4.100	0.497	<0.001	0.387 to 0.609
4	Emergencias	2010	3.173	0.026	0.627	-0.094 to 0.146
5	Burns and Trauma	2018	3.008	0.515	-	-
6	Academic Emergency Medicine	2000	3.064	0.076	<0.001	0.053 to 0.099
7	Emergency Medicine Journal	2002	2.491	0.108	<0.001	0.097 to 0.119
8	Scandinavian Journal of Trauma Resuscitation and Emergency Medicine	2010	2.370	0.063	0.020	0.013 to 0.114
9	Prehospital Emergency Care	2008	2.290	0.107	<0.001	0.065 to 0.150
10	European Journal of Emergency Medicine	2009	2.170	0.128	0.001	0.065 to 0.192
11	European Journal of Trauma and Emergency Surgery	2009	2.139	0.193	<0.001	0.117 to 0.269
12	Injury-International Journal of the Care of the Injured	2000	2.106	0.104	<0.001	0.070 to 0.140
13	American Journal of Emergency Medicine	2000	1.911	0.014	0.246	-0.011 to 0.040
14	Western Journal of Emergency Medicine	2019	1.807	-	-	-
15	World Journal of Emergency Medicine	2018	1.743	0.306	-	-
16	Canadian Journal of Emergency Medicine	2010	1.656	0.059	0.112	-0.017 to 0.136
17	Emergency Medicine Australasia	2009	1.609	0.066	<0.001	0.048 to 0.084
18	Emergency Medicine Clinics of North America	2000	1.528	0.047	<0.001	0.028 to 0.066
19	BMC Emergency Medicine	2019	1.480	-	-	-
20	Journal of Emergency Nursing	2007	1.430	0.082	<0.001	0.046 to 0.119
21	Prehospital and Disaster Medicine	2017	1.315	0.172	0.267	-0.084 to 1.148
22	Journal of Emergency Medicine	2001	1.224	0.034	<0.001	0.017 to 0.052
23	Pediatric Emergency Care	2000	1.17	0.037	<0.001	0.032 to 0.043
24	Emergency Medicine International	2017	0.841	0.161	0.544	-2.186 to 2.508
25	Unfallchirurg	2000	0.704	0.008	0.006	0.003 to 0.015
26	Ulusal Travma ve Acil Cerrahi Dergisi-Turkish Journal of Trauma & Emergency Surgery	2009	0.641	0.040	<0.001	0.027 to 0.054
27	Australasian Emergency Care	**2018	0.542	-	-	-
28	Notfall & Rettungsmedizin	2009	0.516	0.004	0.649	-0.018 to 0.028
29	Notarzt	2009	0.460	0.040	<0.001	0.021 to 0.059
30	Signa Vitae	2008	0.338	0.009	0.112	-0.003 to 0.022
31	Hong Kong Journal of Emergency Medicine	2010	0.214	0.006	0.090	-0.001 to 0.015

*Rank according to journal impact factor of 2019.

**2018 JCR Impact factor not available.

CI, confidence interval.

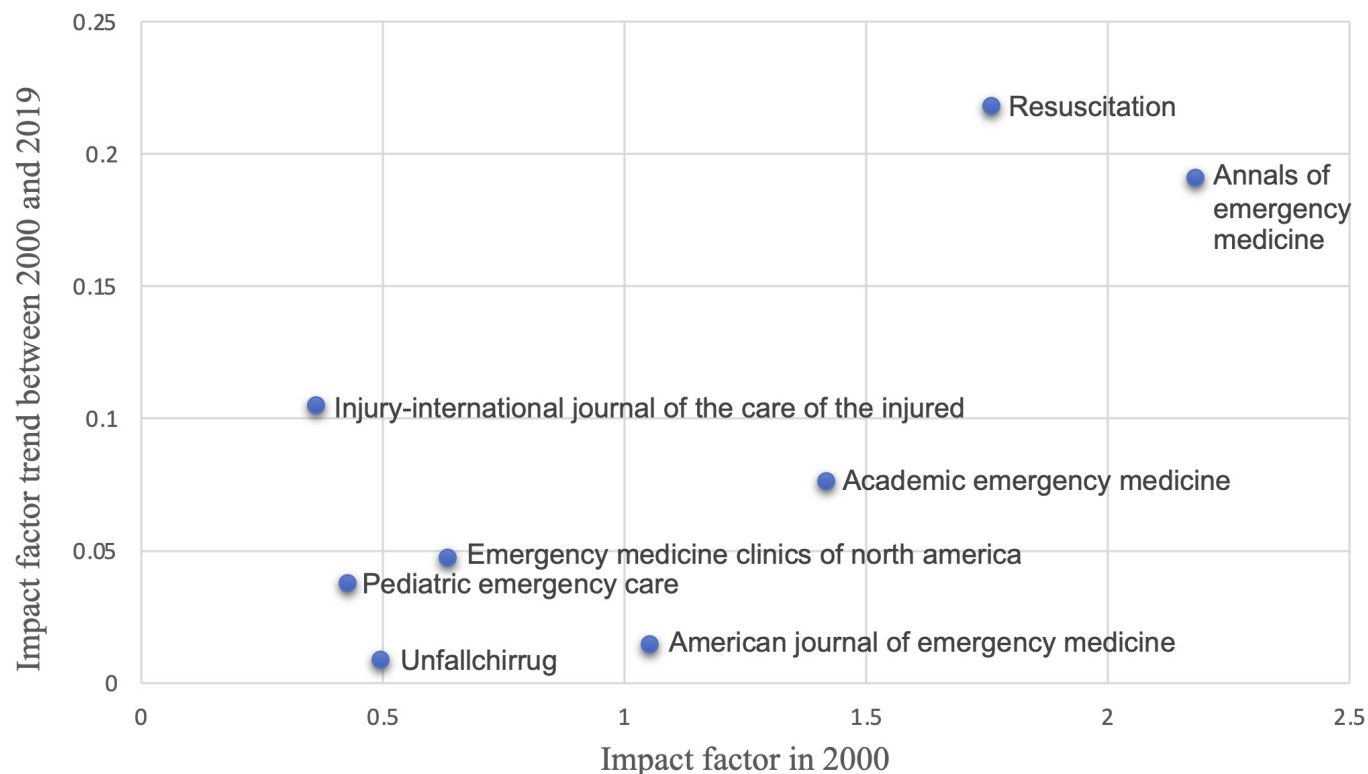


FIGURE 1. Correlation between the impact factor of the eight EM journals enrolled since 2000 and their impact factor trend between 2000 and 2019.

in the number of citable items was -0.58 .

3.3 Category journal numbers and aggregate IF trend

The journal numbers in the 12 categories increased since 2000 ($p < 0.05$) (Table 2). All 12 categories had a positive trend in aggregate IF since 2003, which was significant ($p < 0.05$) for all categories except general and internal medicine ($p = 0.655$) (Table 3). The aggregate IF of the EM category was 1.127 in 2003 and 2.069 in 2019.

4. Discussion

4.1 Developmental history of academic EM

Emergency Medicine (EM) is a rapidly expanding specialty [15]. A study conducted by Lee *et al.* [6] reported an increase in the number of EM journals and the trend of journal impact factors (IFs) from 2000 to 2009, pointing to an enhancement in both the quantity and quality of EM scientific research.

On the other hand, a study by Zhang *et al.* [16], which compared the IF trends of nine subspecialty journals in the field of internal medicine between 1998 and 2010, found that not all subspecialty journals within internal medicine experienced a significant increase in their IF trends.

EM is a relatively young independent specialty, and has not been extensively compared with other medical specialties. From 2006 to 2010, the IF and IF trend of EM journals ranked lower than 31 medical or surgical specialties [13]. Several studies have delved into aspects such as EM journal article numbers, EM journal IF trends, most-cited articles, and author-

ship within the field [17–22]. No study has compared academic performance between EM and other medical specialties after 2010. This is the only study of the performance of academic EM journals in comparison with other medical specialties over two decades.

4.2 Evolution of EM journals

The number of EM journals increased almost fourfold from 2000 to 2019. The new journals focused on a variety of domains of EM, indicating the increased diversity of EM research. The language of all EM journals was English in 2000. In 2019, 20% of EM journals were published in a non-English language, indicating the increasing contribution of non-English speaking researchers to academic EM in the past two decades. All 28 of the 31 EM journals in 2019 whose IF trend could be calculated showed an increase, which was significant for 18 (64%) of them. The IF trend from 2000 to 2019 was highly correlated with the IF in 2000. This phenomenon occurred over a 10-year period and is explained by a positive-feedback hypothesis [6]. Publications appearing in journals with a high IF are more frequently cited. In the publish or perish academic world, more citations imply more impact, funding, and promotion. Authors are prone to initially submit studies to higher-IF journals to maximize the number of citations. High IF journals are more likely to review a variety of studies and accept only rigorous ones. Rigorous studies are more likely to be cited and increase the IF of the publishing journals. This forms a positive-feedback loop. Our results suggest that the positive-feedback hypothesis applies to a 20-year period. Academic EM is a growing field with an

TABLE 2. Trend of journal numbers of all categories in 2000 to 2019.

*Category	Journal numbers in 2000	Journal numbers in 2019	Trend of journal numbers	p-value	95% CI
Cardiac and cardiovascular systems	63	138	4.576	<0.001	3.911 to 5.242
Clinical neurology	137	204	4.259	<0.001	3.581 to 4.938
Critical care medicine	15	36	1.133	<0.001	1.002 to 1.265
Emergency medicine	12	31	1.119	<0.001	0.896 to 1.343
Gastroenterology and hepatology	45	88	2.550	<0.001	2.181 to 2.920
Infectious diseases	36	92	3.283	<0.001	3.023 to 3.544
Medicine, general and internal	105	165	3.900	<0.001	2.919 to 4.883
Pediatrics	71	128	3.884	<0.001	3.259 to 4.511
Respiratory system	29	64	2.072	<0.001	1.874 to 2.272
Surgery	136	210	4.700	<0.001	3.702 to 5.699
Toxicology	77	92	1.093	<0.001	0.825 to 1.362
Urology and nephrology	43	85	2.274	<0.001	2.023 to 2.525

*Category rank according to alphabetical order.
CI, confidence interval.

TABLE 3. Aggregate impact factor (IF) trend of all categories in 2003 to 2019.

*Category	Aggregate IF in 2003	Aggregate IF in 2019	Aggregate IF trend	p-value	95% CI
Cardiac and cardiovascular systems	3.372	4.361	0.058	<0.001	0.044 to 0.073
Clinical neurology	2.367	3.513	0.069	<0.001	0.061 to 0.077
Critical care medicine	3.251	4.738	0.108	<0.001	0.093 to 0.122
Emergency medicine	1.127	2.069	0.052	<0.001	0.042 to 0.062
Gastroenterology and hepatology	3.168	5.161	0.106	<0.001	0.083 to 0.128
Infectious diseases	2.995	3.671	0.020	0.022	0.003 to 0.037
Medicine, general and internal	3.971	4.391	0.006	0.655	-0.024 to 0.036
Pediatrics	1.464	2.244	0.042	<0.001	0.035 to 0.050
Respiratory system	2.897	4.089	0.084	<0.001	0.073 to 0.094
Surgery	1.595	2.558	0.056	<0.001	0.047 to 0.065
Toxicology	1.971	3.370	0.076	<0.001	0.069 to 0.084
Urology and nephrology	2.594	3.285	0.040	<0.001	0.029 to 0.051

*Category rank according to alphabetical order.
CI, confidence interval.

increasing number of journals. New journals may not have a high IF. The IF trend for new EM journals may not be as high as for long-standing journals, increasing the gap over time. From the perspective of newly included EM journals, the solution is to break the cycle by attracting more submissions with rigorous studies and obtaining more citations, resulting in a higher IF trend regardless of their initial IF (when they were initially enrolled into the category of EM). This might enhance the performance of newly included EM journals, decrease the gap between journals, and increase academic performance in EM. It could also be an interesting topic for another study.

The aggregate IF represents the average academic performance of a category. A journal with an IF higher than the aggregate IF can be viewed as a leading journal. These leading journals are more likely to review a variety of studies because authors are more willing to initially submit studies to these journals. IF is determined as the ratio of cited and citable items. Discordance between these two parameters leads to fluctuations in IFs. In the EM category, the correlation between the IF trend from 2003 to 2019 of four leading journals in 2003 and the fold increase in the number of citable items during the same period was moderately negative. The relationship between publication number and IF is a delicate balance and is considered by journal editors.

4.3 Developmental trend of categories

The journal numbers and aggregate IFs of EM and the other 11 categories increased steadily. This reflects the increasing trends in quality and quantity of medical research. The development of EM was non-inferior to the other specialties over the past two decades.

5. Limitations

This study has four limitations. First, the data were obtained from the JCR database, an English-dominant database [14]. This may not be a major concern because EM was initially developed in English-speaking countries; however, as the development of EM spread globally, the contributions of non-English speaking researchers may have been underestimated. Second, we used IF to define journal performance. There are other methods of evaluating journal academic performance, including the h-index. Third, the JCR is the most popular journal database but there are other journal databases, including the Scimago Journal & Country Rank database [23], which included 90 EM journals in 2019. Fourth, our study does not take into account the influence of COVID-19 on the impact factor of EM journals. We collected data up to 2019, prior to the onset of the COVID-19 pandemic. With the surge in COVID-19 publications, which are more likely to be cited, journal impact factors have potentially been inflated [24]. The effect of COVID-19 on the impact factor of EM journals warrants separate investigation.

6. Conclusions

The academic performance of EM has increased in the past two decades. Increased journal numbers and publishing languages

indicate enhanced quantity and diversity. The increasing IF trend of EM journals indicates increased citation frequency, which represents a stronger correlation between the research topic and other related studies. The IFs of EM journals with higher initial IFs increased more rapidly, leading to a wider IF gap between EM journals. Strategies to facilitate the international development of academic EM and narrow the gap are needed. The overall performance of EM journals was non-inferior to those in other medical specialties.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

AUTHOR CONTRIBUTIONS

WMC, CHL—designed the research study. WMC, CHL—performed the research. WMC—analyzed the data. WMC, CHL and CWC—wrote the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study met the criteria for an exemption from our Institutional Review Board of Chang Gung Medical Foundation. “Consent to participate” is not applicable.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

SUPPLEMENTARY MATERIAL

Supplementary material associated with this article can be found, in the online version, at <https://oss.signavitae.com/mre-signavitae/article/1734375763646267392/attachment/Supplementary%20material.docx>.

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